Optimization of pulsed electric field parameters to improve the technological properties and increase the soluble dietary fiber content of carrot pomace through response surface methodology

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Huge amounts of vegetable wastes are generated from juice production. Carrot pomace is an excellent source of dietary fiber (DF). However, the incorporation into food products is difficult because of the high content of insoluble dietary fiber (IDF). Consequently, there is a great interest in modifying the structure for increasing the content of soluble dietary fiber (SDF) and improving the technological properties. Pulsed electric fields (PEF) is a non-thermal processing technology, which can modify the structure and properties of different biomolecules. This study focuses on establishing the optimal parameters for PEF treatments applied with the aim of improving the technological properties and increasing the SDF content of carrot pomace.
For this, a central composite design with 2 independent factors has been used: number of pulses (n) and electric field strength (E = kV/cm). For each factor, extreme lower and upper values were identified (E = 5 - 7 kV/cm; n = 5 - 125). The response variables analyzed were the water retention (WRC), oil retention (ORC), cation exchange (CEC), water swelling (WSC), stabilizing (SC) and emulsifying capacity (EC), solubility, and DF content (SDF and IDF). The validity of the experimental design was confirmed by ANOVA and the optimal conditions were established by response surface methodology.
The high determination coefficients (R2), the non-significant lack of fit ($p>0.05$), and the high F-values indicate that the models were significant ($p<0.001$) and could be used to predict the response. Based on the models, conditions were obtained leading to optimal technological properties and SDF content. Carrot pomace treated at 7 kV/cm and 75 pulses showed higher WRC (61.6%), SDF content (27.4%), ORC (10.41%), CEC (9.6%), WSC (10.4%), SC (11.7%), EC (13.7%) and solubility (36.8%), and lower IDF content (15.5%), compared to untreated pomace.
Therefore, the treatment with PEF under optimal conditions has proven to be an effective method for improving the technological properties and increasing the SDF content of carrot pomace, thus facilitating its incorporation as a functional ingredient to formulated foods.